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Discussion

Discussion: ''Internal Bearing Chamber Wall Heat Transfer as a Function of Operating Conditions and Chamber Geometry'' [ASME J. Eng. Gas Turbines Power, 122, No. 2, pp. 314–320][1]

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The subject under investigation is very important to the gas turbine industry, and the derivation of a correlation for the oil chamber wall heat transfer coefficient is long past overdue. The complexity, however, is that the correlation needs to represent the two-phase flow regime (liquid oil + air) along the chamber wall which changes with engine operating conditions. Therefore, the proposed correlation in this paper requires further validation in order to delineate the effect of two-phase flow regime. Would the authors comment on why the definition of the Reynolds number (Eq. (12)) is not based on local tangential velocity ($n_s \times r_s$) but rather a pseudo tangential velocity based on circumference ($n_s \times 2\pi r_s$). Also, if the chamber circumference is $U=\pi D_h$, why are the Reynolds numbers of Eqs. (15) and (16) written without the π?

[1]Busam, S., Glahn, A., and Wittig, S., 2000, ASME Journal of Engineering for Gas Turbines and Power, **122**, No. 2, pp. 314–320.

Closure to ''Discussion of 'Internal Bearing Chamber Wall Heat Transfer as a Function of Operating Conditions and Chamber Geometry' '' [ASME J. Eng. Gas Turbines Power, 122, No. 2, p. 366]

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The authors appreciate Dr. Mirzamoghadam's comments and like to thank him for his interest in this work. The subject of two-phase flows in bearing chambers is indeed very complex. However, considering steady-state operation at various engine thrust settings, flow visualization studies as well as oil film velocity and thickness measurements along the internal bearing chamber housing walls have shown that flow regimes at the chamber walls do not change fundamentally over the flight envelope. Although it has been recognized for typical engine speeds that the gas liquid interface, i.e., the film surface, turns into a foamy air/oil layer, it has also been shown by oil film profile measurements [1,2] that the time-averaged flow behavior can be described even for highest speeds by analytical methods. In combination with core flow velocity information and local mass balances for the oil film, these methods can be applied to calculate heat transfer coefficients along the circumference of the internal housing wall. The present paper, however, deals with spatially averaged internal bearing compartment heat transfer. Based on our flow and heat transfer investigations at relevant engine conditions, we believe that the main drivers for this circumstance are the rotational speed, the flow rates, and geometrical boundary conditions. Therefore, the correlation, which aims at providing easy-to-use system-level information for calculating heat transfer to the oil, has been derived as a function of the appropriate non-dimensional quantities. Relative to the effect of rotational speeds on the heat transfer, a common definition of a gap Reynolds number, based on the rim speed of the shaft ($C_S=\omega_S r_S=2\pi n_S r_S$), has been used. All Reynolds numbers were based on the hydraulic diameter and not—as interpreted by Dr. Mirzamoghadam—on the chamber circumference.

References

[1] Glahn, A., and Wittig, S., 1996, ''Two-Phase Air Oil Flow in Aero-Engine Bearing Chambers—Characterization of Oil Film Flow,'' ASME J. Eng. Gas Turbines Power, **118**, No. 3, pp. 578–583.
[2] Glahn, A., and Wittig, S., 1999, ''Two-Phase Air/Oil Flow in Aero-Engine Bearing Chambers—Assessment of an Analytical Prediction Model for the Internal Wall Heat Transfer,'' Int. J. Rotating Machinery, **5**, No. 3, pp. 155–165.

